USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

Title: Reuse of AMD Sludge in Conjunction with Membrane Process for Industrial Wastewater Treatment

Federal Funds: $10,000

Non-Federal Funds: $27,084

Focus Categories: TRT, WW, WQL

Descriptors: AMD, Sludge, Reuse, Iron Oxides, Membranes, Wastewater, Treatment

Duration: 3/1/1999 - 2/28/2000

Fiscal Year 1999 Federal Funds:

- Total: $10,000
- Direct: $10,000
- Indirect: $0

Non-Federal Funds Allocated:

- Total: $27,084
- Direct: $15,400
- Indirect: $11,684

Principle Investigator: Yu-Jung (YJ) Chang, West Virginia University

Congressional District: West Virginia District 1

Critical Regional or State Water Problem(s).

Coal mining industries in West Virginia generate large quantity of acid mine drainage (AMD) which contains high concentration of iron. Since the percolation of AMD into the ground or discharge into rivers will cause groundwater and surface water contamination, AMD must be collected and treated to minimize its environmental impact.

After appropriate oxidation and pH adjustment, soluble iron ions precipitate in the form of ferric hydroxides and are eventually removed from the water by settling or other physical separation processes. Due to large quantity of iron oxide sludge produced from AMD each year, the treatment and disposal of this sludge post significant operational costs. Seeking alternative approach to process or reuse the AMD sludge becomes an important issue for mining industry.

Results, Benefits, and/or Information Expected

Some iron oxides species (e.g., ferric hydroxides and goethite) have been proved to be good adsorbents for many metal ions and some natural organic compounds. The PI has nine years of research experience on using iron oxides for wastewater treatment. Since iron oxides in the AMD sludge do not undergo any high temperature treatment, most of them are in the form of amorphous ferric hydroxides and it is expected that these iron oxides can be used to treat local industrial wastewaters which contain metal ions, such as Cu, Pb, or Ni. The reuse of AMD sludge will significantly reduce, if not completely eliminate, the cost of sludge processing for mining industry and also provide an economical approach for local industries to reduce the pollution level of their wastewater.

Nature, Scope, and Objective of the Research

Historically, coal mining is one of the most important industry in the State of West Virginia. Although alternative energy sources have been explored extensively using modern technologies, coal is still the most abundant and reliable energy source in the near future. However, in order to progress along with the technologies and concepts in the new era, coal mining industry is facing the challenge of environmental issues related to mining practices. Acid mine drainage (AMD) is one of the major environmental concern in coal mining process since it contains a wide variety of undesirable constituents, such as manganese, iron, and aluminum, which are toxic to aquatic life. In order to minimize the environmental impact, AMD is collected and treated by physical/chemical processes to precipitate the metals. AMD usually contains extremely high iron and sulfate concentrations. Consequently, ferric hydroxides (one form of iron oxides) are the major constituents in AMD sludge. The quantity of ferric hydroxide sludge resulted from AMD is so large that it contributes a significant portion of the cost of AMD remediation.

Iron oxides have been proved to be excellent adsorbent for many metal ions. The PI has been using iron oxides for both wastewater and potable water treatment in the past nine years. In these researches, iron oxides were either coated on the surface of granular sand grains to form a patented adsorbent (IOCS) or used in a patent pending membrane separation process. In both application configurations, iron oxides were able to remove a wide variety of contaminants, including Cu, Zn, Ni, Cr, Pb, As, and natural organic matter (NOM). Another potential benefit of using iron oxides as adsorbents is that surface charge (both polarity and intensity) of iron oxides can be easily altered by adjusting the solution pH. This special feature allows the use of iron oxides for the removal of either caions or anions depending on the solution pH. Also, the used (or saturated) iron oxides can be easily regenerated in-situ by reversing the solution of pH from alkaline to acidic (incase of cationic metal adsorption) and thereby can be refreshed and reused.

The ultimate goal of this research project is to evaluate the possibility of utilizing the AMD sludge which is enriched in iron oxides as the source of adsorbents for the treatment of many industrial wastewaters. Specific objectives associated with this goal include: (1)evaluate the effect of other metal constituents on the feasibility of using AMD

sludge in industrial wastewater treatment; (2)evaluate the sorption capacity of the AMD sludge for various metal ions found in industrial wastewaters; (3)evaluate the regenerability of the used AMD sludge for continuous usage; (4)evaluate the feasibility of using AMD sludge in a novel sorption/membrane hybrid process.